

JOINING CONSTRUCTION FOR PLATE-LIKE STRUCTURAL MEMBERS

FIELD OF THE INVENTION

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The present invention relates to a joining construction for plate-like structural members, more particularly to a construction for joining a pillar member provided in the form of a plate with a beam member provided also in the form of a plate via a force transmitting member therebetween.

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BACKGROUND OF THE INVENTION

In recent years, as structural members, those formed of such artificial materials as steel, concrete, etc. other than natural materials such as wood have been used. In this respect, plate-like structural members made of glass or synthetic resin are beginning to be used in certain applications. In particular, there is a growing interest in structural members using translucent materials such as glass plates. Such plate-like structural members comprised of glass plates are already in use in both a roof and wall of some building constructions. Figs. 20 and 21 show such application of glass plates as plate-like structural members.

According to a typical known construction for joining such plate-like structural members comprising glass plates, first a plate-like pillar member 1 will be installed erect at a site. Then, to this installed pillar member, a plate-like beam member 2 comprised also of a glass plate will be attached. In doing this, the conventional practice is providing rigid joining construction between an end portion 4 of the plate-like pillar member 1 and an end portion 5 of the plate-like beam member 2 so that the members 1, 2 are rigidly fixed not to be pivotable relative to each other. Specifically, first, metal joining members 12 are secured on the ends 4, 5, respectively. Each

of these members 12 is provided in the form of a plate-like member which can be engaged and fixed to the plate-like pillar member 1 or to the plate-like beam member 2. Next, fasteners 16 such as bolts are inserted into through holes defined in the respective metal joint members 12 and also in the respective ends 4, 5. Thereafter, either the plate-like pillar member 1 or the plate-like beam member 2 is secured to the respective ends 4, 5, and the two metal joint members 12 are fastened together by operating the fasteners 16. Thus, the fasteners 16 and the metal joint members 12 together constitute a force transmitting member or means 7 provided at a jointing portion 3 between the plate-like pillar member 1 and the plate-like beam member 2.

More particularly, an engaging portion 13 of a first metal joining member 12A, one of the metal joining members 12, is fitted sideways over an upper end portion 4 of the plate-like pillar member 1. Thereafter, the plurality of fasteners 16 are inserted into the through holes defined in the plate-like pillar member 1 and the first metal joint element 12A and then operated to fasten the first metal joint member 12A to the plate-like pillar member 1, thereby to form a joining portion 3 at the upper end 4 of the plate-like pillar member 1. Likewise, a second, i.e., the other, metal joining member 12B is fixed to the plate-like beam member 2, so as to form a corresponding joining portion 3 at one end 5 of this plate-like beam member 2. Thereafter, connecting portions 14 of the two metal joining members 12A, 12B are connected to each other via a connecting block 15 interposed therebetween by using the fasteners 16, whereby the plate-like pillar member 1 and the plate-like beam member 2 are rigidly joined to each other.

Now, suppose the plate-like beam member 2 is subjected to an external force effective in the direction along the surface thereof thereby to cause an in-plane deformation, such as flexion, in this plate-like beam member 2. In such case, the joining portions 3 of the two members 1, 2 will

be subjected to an associated external bending force effective in the direction parallel to a plane including both the dynamic axis of the plate-like pillar member 1 and the dynamic axis of the plate-like beam member 2. However, in order to compensate for their weakness to bending deformation in an off-plane direction, the plate-like structural members are disposed such that a major component of the inner stress resulting from the external force will be effective along the in-plane directions of these plate-like structural members. Moreover, since these members, i.e., the plate-like pillar member 1 and the plate-like beam member 2, are rigidly jointed to each other, this joining construction can provide high rigidity against in-plane external forces.

Notwithstanding the above, the glass plate member employed as a plate-like structural member has a weaker tensile strength than compressive strength. For instance, even a small deformation, if occurred, can result in breakage of the member at its portion where it is subjected to such tensile stress. Hence, according to the conventional construction, the joining portions 3 are firmly joined to each other by using the metal joining members 12. However, in the case of an earthquake or the like, there will develop significant relative displacement between the plate-like pillar member 1 and the plate-like beam member 2, which displacement causes an in-plane bending external force acting on both the plate-like pillar member 1 and the plate-like beam member 2.

In general, structural analysis is difficult tending to result in low analytical precision for such construction which can be subjected to an in-plane external bending force and which is made of a glass plate having a small tolerance for tensile strain. Therefore, there arises need for increasing its safety coefficient, hence, need for physically enlarging the metal joining members 12. As a result, transparency of such construction using glass plates would be impaired.

In view of the above, an object of the present invention is to provide

improvement in the joining construction for plate-like structural members through simplification of the force transmission relationship between the plate-like pillar member and the plate-like beam member at the joining portions thereof so as to allow economical design, as well as compactness of the joining members and moreover a greater range of relative angular displacement.

SUMMARY OF THE INVENTION

The joining construction for plate-like structural members proposed by the present invention has the basic characterizing feature of the plate-like pillar member and the plate-like beam member being joined to be pivotable relative to each other as well as other unique features to be described respectively below.

The plate-like structural members joining construction relating to claim 1 is characterized in that an end of the plate-like pillar member and an end of the plate-like beam member are joined via a pin member acting as a force transmitting member so that the pillar member and the beam member are pivotable relative to each other about the pin member. Referring to Figs. 4 and 5 showing an example of such construction, the plate-like pillar member defines, at an upper end thereof, a pin hole for rotatably receiving the pin member therein. To one end of the plate-like beam member, there is fixed a joining member 6 which also defines a pin hole. Then, by inserting a pin into the two pin holes, the plate-like members are joined to be pivotable relative to each other.

With the above construction, it is possible to restrict in-plane bending deformation affecting the plate-like pillar member, thus preventing breakage of this plate-like pillar member due to bending stress. Specifically, the construction acts to restrict the bending moment from being transmitted from the plate-like beam member to the plate-like pillar member, so that

the in-plane bending load affecting on the plate-like pillar member may be restricted. For instance, when a vertical displacement should occur at the other end of the plate-like beam member, the plate-like beam member can pivot about the pin member, whereby this displacement occurring at the other end of the plate-like beam member can be prevented from being transmitted as a moment to the plate-like pillar member. Consequently, if the plate-like pillar member and/or the plate-like beam member are formed of fragile material, breakage of the members formed of such fragile material may be circumvented.

According to the plate-like structural members joining construction relating to claim 2, as shown in Fig. 1 for example, a pair of joining members are pivotably interconnected via the pin member, one of the joining members being fixed to the end of the plate-like pillar member and the other joining member being fixed to the end of the plate-like beam member. Further, the pin member is disposed on the outer sides of the plate-like pillar member and the plate-like beam member. More particularly, of the pair of joining members, the first joining member is fixed to the end of the plate-like pillar member and the second joining member is fixed to the end of the plate-like pillar member.

With the above construction, the joining members are fixed respectively to the end of the plate-like pillar member and the end of the plate-like beam member, so that these joining members are pivotably interconnected via the pin member acting as a force transmitting member. Hence, it is possible to minimize the external bending force affecting on the plate-like pillar member. And, this external force transmitted via the pin member may be transmitted in a dispersed manner via the fixing portions of the joining members to both the plate-like pillar member and the plate-like beam member. Whereby, local concentration of load applied to the two plate-like members may be restricted. As described above, with this construction, it is possible to restrict the in-plane bending stress in the

plate-like pillar and beam members, thus avoiding breakage of these members even when they are formed of fragile material.

According to the plate-like structural members joining construction relating to claim 3, as shown in Fig. 4 for example, the pin member is
5 disposed within a vertical disposing width of the plate-like pillar member. An example of realizing this construction is to form the pin hole for introducing the pin member in and through the plate-like pillar member.

With the above construction, the vertical load applied to the plate-like pillar member from the plate-like beam member is transmitted to the
10 plate-like pillar member within its vertical disposing width. Therefore, bending deformation of the plate-like pillar member may be minimized.

According to the plate-like structural members joining construction relating to claim 4, as shown in Figs. 7 and 8 for example, the plate-like pillar member and the plate-like beam member are joined in such a manner
15 that the dynamic axis of the plate-like pillar member and the dynamic axis of the plate-like beam member are located in a common plane. In this case too, the pin member will be disposed within the vertical disposing width of the plate-like pillar member. In this joining construction, there are provided two plate-like pillar members disposed erect. And, at the upper
20 ends of these plate-like pillar members, pin holes are defined in and through the two plate-like pillar members in the plate thickness direction thereof. Then, the plate-like beam member is interposed between the two opposed plate-like pillar members, and the pin member is inserted into the pin holes of the plate-like pillar members and the other pin hole defined at the end of
25 the plate-like beam member, thereby to join the pair of plate-like pillar members with the plate-like beam member together. Under this condition, the dynamic axes of the pair of plate-like pillar members and the dynamic axis of the plate-like beam member intersect and are located within a common plate.

30 With the above construction, when an external force is applied from

the plate-like beam member to the plate-like pillar members, the construction can effectively restrict bending force affecting the plate-like pillar members for tending to bend these pillar members away from their planes. Consequently, breakage of these plate-like pillar members may be avoided. The dynamic axis of the pair of plate-like pillar members acting as one combined or integrated pillar member is located between these plate-like pillar members. Thus, if the plate-like beam member is supported therebetween, the dynamic axis of this plate-like beam member will intersect the dynamic axis of the plate-like pillar members. And, as these axes are located in a common plate, it is possible to restrict the off-plane external force affecting on the plate-like pillar members. Hence, this construction can effectively compensate for the inherent weakness of such plate-like member against external off-plane bending force. Consequently, breakage of the plate-like pillar member associated with external off-plane bending force may be effectively avoided even when this plate-like pillar member is formed of a glass plate which has lower tensile strength than compressive strength.

According to the plate-like structural members joining construction relating to claim 5, in any one of the above-described joining constructions, at least one of said plate-like pillar member(s) and the plate-like beam member is formed of a glass plate.

By means of the non-rigid joining construction between the plate-like structural members, i.e., the plate-like pillar member and the plate-like beam member, by using the pivotable joining member therebetween, the force transmission relationship between the plate-like pillar member and the plate-like beam member at their joining portions is simplified, so that degree of redundancy may be reduced. As a result, the precision of structural analysis of the construction may be enhanced for allowing economical designing of the same. Further, by using e.g. the pin member at the joining portions, the aesthetic appearance of the joining member may

be improved, when compared with the conventional rigid joining construction provided between the plate-like pillar member and the plate-like beam member. Moreover, tolerance for relative angular displacement afforded between the plate-like pillar member and the plate-like beam member may be increased as well.

With the above construction, a glass plate is employed with consideration to the above-described characteristics of the joining construction. And, even when such glass plate is employed, breakage of the plate-like pillar member and/or the plate-like beam member may be avoided. Thus, the joining construction may be provided as a construction with superior light-transmission or translucent property.

Further, the improvement of the aesthetic appearance of the joining member can contribute also to the improvement of aesthetic appearance of the entire glass structural construction. Also, if this joining member is formed slim, the inherent transparency of the glass plate will not be compromised.

Therefore, in e.g., a building construction having a transparent outer wall face, if its pillar member is formed of such plate-like pillar member made of a glass plate, this pillar will not interfere with the view.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing an example of joining portions of plate-like structural members relating to the present invention,

Fig. 2 is a plan view in section showing principal portions of the joining portions shown in Fig. 1,

Fig. 3 is a side view showing principal portions of a joining construction for plate-like structural members relating to the present invention,

Fig. 4 is a perspective view showing another example of joining

portions of plate-like structural members relating to the present invention,

Fig. 5 is a plan view in section showing principal portions of the joining portions shown in Fig. 4,

5 Figs. 6 and 7 are perspective views showing further examples of joining portions of the plate-like structural members relating to the present invention,

Fig. 8 is a plan view in section showing principal portions of the joining portions shown in Fig. 7,

10 Fig. 9 is a perspective view showing still another example of joining portions of plate-like structural members relating to the present invention,

Fig. 10 is a plan view in section showing principal portions of the joining portions shown in Fig. 9,

15 Fig. 11 is a perspective view showing still another example of joining portions of plate-like structural members relating to the present invention,

Fig. 12 is a plan view in section showing principal portions of the joining portions shown in Fig. 11,

20 Fig. 13 is an exploded perspective view of the joining member also shown in Fig. 11,

Figs. 14-16 are side views showing still further examples of joining portions of the plate-like structural members relating to the present invention,

25 Fig. 17 is a perspective view showing still another example of joining portions of glass structural members relating to the present invention,

Fig. 18 is a plan view in section showing principal portions of the joining portions shown in Fig. 17,

30 Fig. 19 is a perspective view showing still another example of joining portions of glass structural members relating to the present

invention,

Fig. 20 is a perspective view showing principal portions of a conventional joining construction of glass structural members, and

Fig. 21 is an exploded perspective view of the joining portions also shown in Fig. 20.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Next, the joining construction of plate-like structural members relating to the present invention will be described with reference to the drawings.

Fig. 1 is a perspective view showing an example of joining portions or a joining construction of a plate-like pillar member and a plate-like beam member relating to the present invention. Fig. 2 is a plan view in section showing the construction from the above. Fig. 3 is a side view in section showing an example in which the above-described joining construction is employed in a building construction. Incidentally, for components providing identical or similar functions to those shown in Figs. 19 and 20 referred to in the above in the description of the prior art, identical or related reference marks or numerals used in Figs. 19 and 20 will be given and some parts of detailed discussion of these components will be omitted here.

As shown in Figs. 1 and 2, a joining member 6 consists of a first joining member 6A and a second joining member 6B. Each of these joining members 6A, 6B includes a pair of members and respectively defines, at one end thereof, a plurality of bolt inserting through holes 9.

The first joining member 6A defines, at the other end thereof, a pin hole 10 in which a pin member 8 acting as a force transmitting member 7 may be pivotably and loosely engaged. This pin hole 10 is defined adjacent a side edge of an end 4 of the plate-like pillar member 1 made of a glass

plate to be retained.

The second joining member 6B also defines, at the other end thereof, a pin hole 10 for pivotably and loosely retaining the pin member 8 therein. In this case too, the pin hole 10 is formed adjacent a side edge of one end of the plate-like beam member 2. The other ends of the members or elements constituting the second joining member 6B can be contacted with each other in the periphery of the pin hole 10. The other end of the second joining member 6B is inserted into a gap formed between the paired members of the first joining member 6A.

Incidentally, in the illustrated example, in order to prevent damage to the plate-like pillar member 1 and/or the plate-like beam member 2, there is provided a gap between the plate-like pillar member 1 and the first joining member 6A and between the plate-like beam member 2 and the second joining member 6B, respectively. And, within each gap, a shock absorber 6a is fitted for maintaining this gap. The shock absorber 6a can comprise a sheet of fiber material, for example. And, this shock absorber 6a can be bonded to the plate-like pillar member 1 and the plate-like beam member 2 by using epoxy bonding agent, elastic bonding agent, emulsion latex bonding agent or the like. Alternatively, such sheet impregnated with the bonding agent may be bonded to the plate-like pillar member 1 and the plate-like beam member 2.

Further, there is formed a gap also between the first joining member 6A and the second joining member 6B for facilitating the relative pivotal movement therebetween.

As shown in Fig. 2, both of the joining members 6A, 6B clamp the end 4 of the plate-like pillar member 1 and the end 5 of the plate-like beam member 2, respectively via the shock absorbers 6a. Into the plurality of inserting holes 9 defined through the respective ends 4, 5, a plurality of fasteners 16, such as bolts, having shock absorbers 17 fitted thereon are inserted, whereby the joining members 6A, 6B are fixed to the respective

ends 4, 5. And, these joining members 6A, 6B fixed to the ends 4, 5 are joined together via the pin member 8 acting as the force transmitting member 7 loosely held within the pin hole 10.

5 In the illustrated example, the first joining member 6A is fixed to the upper end 4 of the plate-like pillar member 1 and the second joining member 6B is fixed to the end 5 of the plate-like beam member 2. Incidentally, the opposed heads of the fasteners 16 are received flush within recesses defined in the joining members 6A, 6B so that these heads do not project outside the joining members 6A, 6B.

10 With the above-described construction, the plate-like pillar member 1 and the plate-like beam member 2 are pivotably joined to each other via the pin member 8. Hence, when a relative angular displacement occurs in the plate-like beam member 2 relative to the plate-like pillar member 1, these members are pivoted relative to each other to prevent in-plane bending moment from occurring in the plate-like pillar member 1. Further, as this construction has eliminated the necessity of bearing the bending moment, the joining members 6 may be formed small also.

20 In addition, since the joining members 6 are attached to the respective ends of the plate-like pillar member 1 and the plate-like beam member 2 over a predetermined area relative thereto, the force transmitted via the pin member 8 to the plate-like pillar member 1 and the plate-like beam member 2 may be distributed appropriately between the plate-like pillar member 1 and the plate-like beam member 2. As a result, it becomes possible to restrict damage to the plate-like pillar member 1 and the plate-like beam member 2 each of which is formed of a glass plate which is said to be generally weaker in its tensile strength than its compressive strength.

25 Moreover, as the joining portions or construction 3 may be formed small, if, in particular, the plate-like pillar member 1 and the plate-like beam member 2 are formed of glass plates, the translucency may be maintained for betterment of aesthetic appearance.

Fig. 3 shows an example in which the joining portions or joining construction 3 relating to the present invention is employed in a sightseeing room of a building construction. The plate-like pillar member 1 is mounted on an exterior structural member 25, whereas the plate-like beam member 2 is mounted to an outer end of a roof extension 24 overhung from a side structural member 23. The exterior structural member 25 is a retaining wall of the sight-seeing room projecting from the building construction. The side structural member 23 is a portion of the roof extension 24 overhung from a wall of the building construction. Both the plate-like pillar member 1 and the plate-like beam member 2 are formed of glass plates and are joined to each other via the joining member 6. The plate-like pillar member 1 is attached via a pin member 8 between a pivot metal element 20 mounted on the exterior structural member 25 and a joining metal element 19 fixed to the lower end of the plate-like pillar member 1. Similarly, the plate-like beam member 2 is attached via a pin member 8 between a pivot metal member 20 mounted to the outer end of the roof extension 24 and a joining metal element 19 fixed to the other end of the plate-like beam member 2. Preferably, like the above-described attachment of the joining member 6, shock absorbers may be fitted between the joining metal elements 19 and the lower end of the plate-like pillar member 1 and the other end of the plate-like beam member 2.

Incidentally, a similar joining construction to that of the joining portions 3 described hereinbefore is provided between the end 4 of the upper end of the plate-like pillar member 1 and the end 5 of the one end of the plate-like beam member 2. Between the upper end of the plate-like pillar member 1 and the upper face of the roof extension 24, there is mounted a window sash to be pivotable relative to the plate-like pillar member 1. And, on this sash, there is mounted a roof panel 21 comprising a double glazing. On the outer side of plate-like pillar member 1, there is attached an exterior wall panel 22 comprising also a double glazing. With this construction, it is

possible to minimize the joining members 6 which would otherwise interfere with the view from the sightseeing room, so that the aesthetic appearance may be improved.

According to the above-described construction, it is possible to allow
5 for relative angular displacement between the plate-like pillar member 1 and the plate-like beam member 2. So that, when a relative displacement occurs between the exterior structural member 25 disposed continuously from the floor of the sightseeing room and the side structural member 23 of the building construction provided as a projection from the sightseeing room,
10 the roof panel 21 and the exterior wall panel 22 may be maintained without damage to these plate-like pillar and beam members 1, 2.

Other embodiments of the present invention than that described above will be described next.

15 <1> In this, as shown in Figs. 4 and 5, in the end 4 of the upper end of the plate-like pillar member 1, there is defined a pin hole 10 for rotatably receiving the pin member 8 as the force transmitting member 7. In the one end 5 of the plate-like beam member 2, there are defined a plurality of inserting through holes 9. While the pair of joining members 6 are placed
20 in contact with the opposed faces of the plate-like beam member 2, these plate-like beam member 2 and the joining members 6 are fixed to each other by using the fasteners 16. Further, a pin hole 10 is defined in the joining members 6. Then, by inserting the pin member 8 with a bush 11 having shock absorber fitted thereon into the two pin holes 10 (see Fig. 5), the pillar
25 and beam members are pivotably joined to each other.

In the case of this construction, the pin member 8 is disposed within the vertical disposing width of the plate-like pillar member 1. As a result, the vertical load applied to the plate-like pillar member from the plate-like beam member is transmitted via the pin member to the plate-like
30 pillar member within the plate width of the pillar member. Accordingly,

bending deformation of the plate-like pillar member may be minimized.

With the above construction, even when the other end of the plate-like beam member 2 is vertically displaced, this plate-like beam member 2 is pivoted about the pin member 8. Hence, in the event of such vertical displacement of the other end of the plate-like beam member 2, it is possible to prevent this displacement from being transmitted as a bending moment to the plate-like pillar member 1.

Moreover, downwardly of the pin hole 10, the plate-like pillar member 1 has a sufficient margin of length to effectively withstand the load applied to this plate-like pillar member 1, so that the pillar member may receive the load in a distributed manner from the plate-like beam member 2, and the possibility of breakage of the plate-like pillar member 1 may be advantageously reduced.

Further, since the pin hole 10 can be located at the dynamic axis X1 of the plate-like pillar member 1 (see Fig. 4), the load from the plate-like beam member 2 is transmitted as an axial force to the plate-like pillar member 1, without generating in-plane or off-plane bending stress in the plate-like pillar member 1. In the case of this construction, it is preferred that a gap be formed between the plate-like pillar member 1 and the joining members 6 in order to allow for the pivotal movement therebetween. This gap can be 1 mm to several mm.

Incidentally, as shown in Figs. 4 and 5, the heads of the fasteners 16 are allowed to project from the outer faces of the opposed joining members 6A, 6B without forming any recesses in these joining members 6A, 6B.

<2> In a further construction shown in Fig. 6, the first joining member 6A has one widened end which defines through holes juxtaposed along the width direction. Then, by inserting the fasteners 16 into these holes, the first joining member 6a is attached to the upper end 4 of the plate-like pillar

member 1. In this case, the pair of joining members 6A are extended upwards and the pin holes 10 are defined at the upper ends thereof. With this construction, the pin member 8 can be located at the dynamic axis X1 of the plate-like pillar member 1, so that the load from the plate-like beam member 2 can be transmitted as an axial load to the plate-like pillar member 1.

Preferably, like the foregoing joining portions 3, shock absorbers 6a are interposed between the first joining member 6A and the plate-like pillar member 1 and between the second joining member 6B and the plate-like beam member 2.

Incidentally, in the construction of Fig. 6, in a reverse arrangement from those described hereinbefore, the upper ends of the pair of first joining members 6A are formed close to each other to be fitted between the other ends of the second joining members 6B and joined via the pin member 8.

Further, in this construction of Fig. 6, the inserting holes defined in the first joining member 6A are arranged in the direction normal to the axis X1. However, the specific arrangement of these inserting holes may vary as desired. For instance, the holes may be arranged in a plurality of rows or arranged in a zigzag pattern.

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<3> If the load applied to the plate-like structural member, i.e., the plate-like pillar member 1 or the plate-like beam member 2, is significant or if it is desired to increase the overhanging amount of the plate-like structural member from the ceiling or wall, it is conceivable to provide a plurality of the plate-like pillar members 1 or plate-like beam members 2 in juxtaposition to decrease the overhanging amount.

In such case, as shown in Figs. 7 and 8 for instance, two plate-like pillar members 1 may be used instead of one. In this case, for disposing the pin member at the dynamic axis X 1 of the plate-like pillar member, two plate-like pillar members are disposed erect in juxtaposition and opposition

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to each other. And, in the upper ends 4 of these pillar members, pin holes 10 are defined through in the respective pillar members 1 along the plate thickness direction thereof. Then, the plate-like beam member 2 is disposed between the opposed plate-like pillar members 1 and the pin member 8 is inserted into the pin holes 10 and also the further pin hole 10 defined at the end 5 of the plate-like beam member 2. In this manner, the pair of plate-like pillar members 1 and the plate-like beam member 2 are joined to each other.

In this case too, between the pin holes 10 and the pin member 8, there may be interposed the bush formed of shock absorber for loosely engaging the pin member 8. Further, the shock absorber 6a may be interposed also between the plate-like pillar members 1 and the plate-like beam member 2, like the foregoing joining portions 3.

With this construction, it is possible to allow the dynamic axis X1 of the pair of plate-like pillar members 1 to intersect the dynamic axis X2 of the plate-like beam member 2 within a same plane. The dynamic axis X1 of the pair of plate-like pillar members 1 as one combined or integral pillar is located between these plate-like pillar members 1. Hence, when the plate-like beam member 2 is interposed therebetween the dynamic axis X2 of the plate-like beam member 2 intersects the dynamic axis X1 of the plate-like pillar members 1. With the two axes X1, X2 being located in the same plane so as to avoid generation of off-plane stress relative to the plane, it is possible to restrict external bending force affecting on the plate-like pillar members 1 formed of glass plates. As a result, it is possible to avoid damage resulting from such external bending force to the plate-like pillar members 1 made of glass plates generally having smaller tensile strength than compressive strength.

Incidentally, the shock absorber 6a is bonded to the plate-like pillar members 1 or the plate-like beam member 2 so as to assure necessary clearance and also to prevent direct contact between the glass and the metal

while maintaining slidability therebetween.

Moreover, in the case of this construction, the joining member 6 is constituted merely by the pin member 8 and the bush 11 adapted for protecting the pin holes 10 of the plate-like pillar members 1 and the plate-like beam member 2. Hence, this joining member 6 may be formed small, thereby to further improve the aesthetic appearance of the glass construction characterized by its transparency.

<4> Instead of the construction described above in <3>, as shown in Figs. 9 and 10 for example, one plate-like pillar member 1 and a pair of plate-like beam members 2 may be used in combination. A pin hole 10 is formed in the upper end 4 of the plate-like pillar member 1 and further pin holes 10 are formed at the end 5 of the pair of plate-like beam members 2. Then, while the plate-like pillar member 1 is interposed between the pair of opposed plate-like beam members 2, the pin member 8 is inserted into the pin holes 10 for joining the pillar and beam members together. The effect of this construction is similar to that achieved by the construction of <3> described above.

Incidentally, as shown in Figs. 11 and 12 for instance, the construction may employ a pair of pillar members 1 as well, so that the pair of pillar members 1 are interposed between the pair of beam members 2 and these are then joined together by inserting the pin member 8 therein.

In this case, as shown in Fig. 13, a spacer 18 may be interposed between the pair of opposed plate-like pillar members 1 for maintaining the distance therebetween. The spacer 18 includes, on opposed sides thereof, shaft portions into which the pin members 8 are to be threaded. Then, a bush 11 which can be loosely fitted on each of these shaft portions is fitted within the pin hole 10. With this, the plate-like pillar member 1 and the plate-like beam member 2 will not be clamped too strongly between the pin member 8 and the spacer 8, whereby damage to the plate-like pillar

member 1 and to the plate-like beam member 2 may be avoided.

Further, by providing the bushes 11, when a gap exists between the plate-like pillar member 1 and the plate-like beam member 2 and the shaft portions of the spacer 18, unnecessary looseness therebetween may be eliminated with appropriately selection of the thickness of the bush 11.

Preferably, a shock absorber 6a should be interposed between the spacer 18 and the plate-like pillar member 1 and between the head of the pin member 8 and the plate-like beam member 2 and also between the plate-like pillar member 1 and the plate-like beam member 2. These shock absorbers 6a may be bonded to the plate-like pillar member 1 or the plate-like beam member 2.

With this construction too, like the construction described hereinbefore in <3>, the dynamic axis X2 of the pair of plate-like beam members 2 and the dynamic axis X1 of the plate-like pillar member 1 may intersect each other. So that, off-plane deformation of the pillar member 1 or the beam members 2 may be avoided.

Incidentally, the spacer 18 may be divided midway in its longitudinal direction for clamping a third plate-like pillar or beam member therebetween.

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<5> Further, in place of the construction shown in Fig. 1, as shown in Fig. 14 for example, the joining member 6 may be fixed to the plate-like pillar member 1 and this joining member 6 and the plate-like beam member 2 may be attached to each other via the pin member 8.

Also, for disposing the pin member 8 within the disposing width of the plate-like pillar member 1 as described in <1> above, as shown in Fig. 15 for example, it is also possible to define a pin hole in the upper end 4 of the plate-like pillar member 1 so as to connect a joining member 6 attached to and downwardly from the end 5 of the plate-like beam member 2 by using the pin member 8 inserted into the pin hole.

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Further alternatively, as shown in Fig. 16 for example, the joining member 6 may fixed to and upwardly from the upper end 4 of the plate-like pillar member 1 and the pin hole may be defined in the end 5 of the plate-like beam member 2, so that the pillar and beam members may be joined together by using the pin member 8 inserted into the pin hole.

<6> A still further construction is shown in Figs. 17 and 18. In this construction, first, the plate-like beam member 2 and a pair of plate-like pillar members 1 are joined to each other in the same manner as the construction shown in Fig. 7. Then, a third plate-like pillar member 1A is disposed along the outer edges of the pair of plate-like pillar members 1 in the direction normal to the faces of these members 1. That is, in a plan view, the third plate-like pillar member 1A is fixed to the pair of opposed plate-like pillar members 1 to form together a hook shape cross section. And, to the upper end 4 of the third plate-like pillar member 1A, a third joining member 6C is attached. Pin holes 10 are defined at opposed ends of this third joining member 6C. Then, transverse plate-like beam members 2A are joined to the respective opposed sides of the third joining member 6C by using the pin members 8.

In this case too, it is preferred that the spacer 18 be interposed between the plate-like beam member 2 and the pair of plate-like pillar members 1.

<7> In the foregoing embodiments, the plate-like pillar member(s) 1 and the plate-like beam member(s) 2 are joined to each other with their faces being oriented along the same direction. Instead, as shown in Fig. 19 for instance, the plate-like pillar member 1 and the plate-like beam member 2 may be joined to each other with their faces being oriented in directions normal to each other. In this illustrated example, the pin holes of the first joining member 6A are formed with their axes being oriented normal to the

thickness direction of the plate-like pillar member 1.

5 <8> In the foregoing embodiments, both the plate-like pillar member 1 and the plate-like beam member 2 are formed of glass plates. And, these constructions have been described as providing the effect of improving the aesthetic appearance of the structural construction because of the translucency afforded by the glass plates. However, either one or both of these plate-like pillar and beam members 1, 2 may be formed of other translucent synthetic resin material such as polyacrylic resin, polycarbonate resin, etc. having an appropriate strength. With using such synthetic resin materials too, the above-described effect and those effects of the joining constructions of the invention described hereinbefore can be achieved equally. Also, even if these plate-like structural member(s) is (are) formed of non-translucent synthetic resin material, the resultant construction can provide the advantage of being lighter than the constructions using steel while effectively preventing damage to the structural members.

20 <9> In some of the embodiments described hereinbefore, only one plate-like pillar member 1 and one plate-like beam member 2 are joined together. However as described also in the foregoing <3>, <4> and <5>, the specific number of these plate-like pillar member 1 and plate-like beam member 2 is not particularly limited. A plurality of either or both of them may be employed.

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What is claimed is:

1. A joining construction for joining plate-like structural members, in which a plate-like pillar member and a plate-like beam member as plate-like structural members are joined to each other via a force transmitting member,
5 wherein an end of the plate-like pillar member and an end of the plate-like beam member are joined via a pin member acting as the force transmitting member so that the pillar member and the beam member are pivotable relative to each other about the pin member.
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2. The plate-like structural members joining construction as defined in claim 1, wherein a pair of joining members are pivotably interconnected via the pin member, one of the joining members being fixed to the end of the plate-like pillar member and the other joining member being fixed to the end of the plate-like beam member, and the pin member is disposed on the outer sides of the plate-like pillar member and the plate-like beam member.
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3. The plate-like structural members joining construction as defined in claim 1 or 2, wherein the pin member is disposed within a vertical disposing width of the plate-like pillar member.
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4. The plate-like structural members joining construction as defined in claims 1, 2 or 3, wherein the pillar-like member and the plate-like beam member are joined in such a manner that the dynamic axis of the plate-like pillar member and the dynamic axis of the plate-like beam member are located in a common plane.
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5. The plate-like structural members joining construction as defined in any one of claims 1-4, wherein at least one of said plate-like pillar
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member(s) and the plate-like beam member is formed of a glass plate.

